stationary like those of the experimental sciences which can be called up at will at any moment; they are in constant movement. Moreover, their movements are not cyclical, like the movements of the planets; they are progressive in an infinite series. Every event which occurs adds something to the environment of every subsequent event and is a factor in its causation; so that the mere fact that a thing has happened once presents an insuperable barrier to its ever happening again. We of the present day, for instance, are divided by an impenetrable wall of new ideas, new discoveries, new conditions from our predecessors of but the last generation. Not even the most deliberate and carefully planned attempts to revert to earlier orders of things—social, religious, political—can possibly result in anything but hopeless failure. History can never be *made* to repeat itself.

That being the case, it is obvious that whatever may be the general principles which historians may deduce from their study of historic phenomena, they will be very different from the rigid and invariable laws of natural science which enable the expert not only to explain the past, but also to predict the future. History, in fact, has closer analogies with the mental and moral sciences than with the natural sciences. It is to the human race almost exactly what memory is to the individual man. No individual man ever finds himself twice in precisely the same situation, nor can anyone discover unvarying sequences of cause and effect in the relations between himself and his fellows; yet, notwithstanding this, every man in his mature life is very largely guided and governed by his experiences as recorded by his memory and by the principles of conduct which his judgment has deduced from them. As with the individual so with the race; but subject to this important difference, that the race lacks that personality, that continuity of self-consciousness, which marks the individual. It has no natural memory, and in order that it may not lose the vast accumulated wealth of the experiences of the past a memory has to be created for it. That race-memory is history. Through history mankind attains to self-consciousness. As Droysen puts it:—"Die Geschichte ist das γνῶθι σαυτὸν der Menschheit, ihr Gewissen." By means of this self-knowledge humanity is able to become to a degree otherwise wholly impossible the master of its fate; it is able to control its destiny, and to move deliberately forward on the pathway of progress.

Now if history is to perform adequately its high function, and to serve the purpose of a universal memory to man, it is plain that it must no longer be left in the hands of the literary artist to be built up of anecdotes, be they told never so brilliantly, or in the hands of the party-politician to be constructed of half truths, be they never so honestly held to be the whole truth. History must be elaborated by the strictest methods of science, even though it is concerned with facts which are beyond the reach of observation and with principles which are not reducible to the satisfying simplicity of law. To state the matter in the briefest outline, which is all that is possible here, scientific method must be applied to history, first, in the discovery of facts; secondly, in the selective classification of facts; and thirdly, in the drawing of inferences from facts.

(1) *The Discovery of Facts.*

In history, the discovery of fact resolves itself mainly into the criticism of documents. So important are documents in historical research that MM. Langlois and Seignobos go so far as to say, in the opening paragraph of their book, "L'histoire se fait avec des documents," and "Pas de documents, pas d'histoire." There *are*, however, other sources of information, for example, oral tradition in the case of contemporary or recent events; archæological, architectural, and monumental remains in the case of more remote eras. Nevertheless, it is correct to say that documents are the primary source of historical knowledge. Concerning documents, the first thing which has to be determined by criticism is their origin—that is to say, their authorship, the date and place of their composition, and their genuineness. Many things have to be taken into account in the determination of these important matters, *e.g.* handwriting and writing materials, vocabulary, internal evidence of knowledge displayed and opinions expressed. When, so far as is possible, the origin of a document has been fixed and its genuineness proved, the problem of the accuracy of its statements has to be entered into. Such questions have to be asked as:—Had the writer opportunities of knowing what he wrote about? Had he sufficient ability to avail himself of his opportunities? Had he any prejudices to distort his judgment? Had he any reason to conceal or pervert the truth? Does his testimony agree with that of other witnesses? Is what he says inherently credible?

(2) *Selection and Classification of Facts.*

The fact that a fact is a fact does not make it important. The historian has to select the facts which are significant from vast masses of the insignificant. What shall be his principle of choice? Shall he select anecdotes which may amuse his readers, or incidents which support the views of some party or sect to which he belongs? The day when he could adopt either of these principles of selection is gone. But even now historians do not by any means agree as to the exact kind of facts that it is the function of history to record. Nor is it necessary that they should agree; no two people store their memory with precisely the same kind of recollections. Seeley and Freeman limited themselves to facts of past politics; Green and Macaulay recorded facts of past social conditions; Droysen and Döllinger, following Schopenhauer and Hegel respectively, looked below the surface of events, the one for the acts of will, the other for the movements of ideas of which events were the manifestation. Any one of these principles, or any similar principle, is sufficient to give a scientific unity to historical research.

(3) *The Drawing of Inferences from Facts.*

Although, as already seen, historical inferences can never have the characteristics of physical laws, and although the completest philosophy of history could never enable the historian to predict revolutions with that unerring certainty with which the astronomer predicts eclipses, yet historical inferences may be thoroughly scientific, and the philosophy of history of the greatest practical value. Given the permanent and unchanging facts of human nature, and known the peculiar circumstances of any particular event, that event can be explained; and though it is true that these circumstances can never by any possibility recur again, yet others will certainly occur sufficiently similar to make the explanations discovered in the one case valuable guides to conduct in the others. Social and political progress and the development of civilisation depend very largely on the adequate learning by the human race of the lessons of experience remembered by means of history.

If in our days kings are benevolent, churches are tolerant, armies are obedient, and policemen are civil; if colonies are well governed; if taxation is equitable; if Ministers of State are honest—all this is due no little to the recorded and thus remembered fates of tyrants, persecutors, rebels, and the rest. Similarly if the admitted imperfections of the present are to be removed, and if progress is to continue, history, rich with its lessons of the past, must remain the light and guide of the future. But it must be not the history of superstition and prejudice and romance, not the boon companion of astrology and alchemy, but the history of exact knowledge and calm judgment, the recognised members of the hierarchy of the sciences.

F. J. C. HEARNSHAW.

PUBLIC SCHOOLS SCIENCE MASTERS' CONFERENCE.

THE annual meeting and conference of the Public Schools Science Masters' Association was held on Saturday, January 20, at Westminster School. Owing to ill-health, which had forced him to go abroad, the president, Sir Oliver Lodge, was unable to be present, and the Rev. E. C. Sherwood (Westminster), chairman of committee, presided at the business meeting, his place being afterwards taken by the retiring president, Sir Michael Foster, K.C.B. The honorary secretary, Mr. W. A. Shenstone (Clifton), relinquished his post, and the Rev. E. C. Sherwood (Westminster) and Mr. Hugh de Havilland

(Eton) were elected to serve in a joint capacity. Mr. J. Talbot (Harrow) was re-appointed treasurer, and the Rev. the Hon. Canon Lyttelton, headmaster of Eton, was unanimously elected president for the year 1907.

Sir Michael Foster, in opening the conference, excused himself from giving an address on the ground that for some time his mind had been filled with very inferior things (Sir Michael referred to the contest for the representation of London University in Parliament). The first paper was read by the Rev. W. Madeley (Woodbridge); its aim was to invite discussions upon the possibility of introducing a comprehensive syllabus of scientific teaching within the time limits of a classical curriculum. Mr. Madeley characterised the fact that there was no compulsory science on the classical sides of public schools as a deplorable anachronism. He pointed out, too, that philosophy was introduced into the classical honours papers at Oxford, and that classical scholars were expected now to know what was meant by the "struggle for existence," "survival of the fittest," "the Glacial epoch," and "the laws of motion," as shown by questions set in examination papers. He suggested that two hours alone per week could be spared in which classical boys could do science, and outlined a general course of what he termed natural philosophy, which he thought would broaden the outlook of the boys and do more for their general education than a training in some special branch of science. Among the items in his syllabus were gravitation, the solar system, the conservation of energy, the indestructibility of matter, the laws of chemical change and combination, Darwinism and evolution.

Sir Michael Foster, in the discussion which followed, said that he sympathised with the wish of Mr. Madeley, who had given them a problem to solve and mentioned the time in which it had to be done. He went on to say that the whole use of science was dependent upon the habit of mind that was acquired, and this, which meant openness, alertness, and power of observing many things, could not be gained by surveying the whole world of science, but by attendance to details. When these had been mastered broader views and generalisations could more easily be grasped.

Mr. W. D. Eggar (Eton) advocated that the two hours should be devoted to laboratory study, and that a very small bit of science should be thoroughly taken up. No lectures should be given, as the boys could read up notions for themselves. Mr. D. Berridge (Malvern) thought that if classical masters prepared a number of foreign phrases for the science boys to learn, so that those met with in the newspapers could be understood, they would be as well equipped from the literary point of view as Mr. Madeley's boys would be in science by the course which he had outlined. Mr. Berridge agreed that the division of the lower school into classical and modern sides militated against the taking of science on the former of these. He suggested that headmasters should try the experiment of making, say, the five subjects of the old London matriculation compulsory for all boys until they were sixteen years of age and ready to specialise. Mr. W. A. Shenstone (Clifton) asked why boys might not have the special and the general training as well, and advocated, in addition to the two hours' work at a particular branch in the laboratory, the attendance of the boys once a fortnight at general lectures, such as those lay addresses given at Clifton on Sunday evenings. Many speakers emphasised the ignorance of the classical boy and man. Mr. Cumming (Rugby) said that the only instrument that they understood when they left school was the pen.

Mr. J. Talbot (Harrow) read the second paper, on the present state of the Army examinations, and began by alluding to the changes which have recently taken place, not only in the standard and arrangement of subjects, but also in their very nature. As he considered that the changes were permanent, he went on to trace the reason for them. For this we must go to South Africa, for the recent war has altered the whole principles underlying the tactics and training of the Army. As Colonel Henderson has pointed out, the discipline used to be entirely mechanical, killing all individuality, and forbidding either officer or man to move without direct order; now, as he says, soldiers must be like a pack of well trained hounds, not running in regular order, but without stragglers, each using his instincts and intelligence, and following up the general aim with relentless perseverance.

Under the old conditions, Mr. Talbot said, brains were not essential in an officer, and any type of entrance examination would do, and did. Now, however, if each officer is to employ the trained initiative which is essential in the new order of things and produce it in his men, it is obvious that his own training as a boy becomes all important. While Woolwich and Sandhurst supply the purely technical training, the science masters have to supply the mind they train, and this must be well developed, inured to hard work, and, above all things, supple.

We are now in a position, continued Mr. Talbot, to understand the division of the examination into two parts. The qualifying examination, or its equivalent, the leaving certificate, is intended to ensure that the boy has a sound general education, the competitive, that he has brains, and unless the standard of the examination is fairly high it is difficult to discriminate between brains and cram.

One of the chief qualifications of the officer is the power of initiative; he is always meeting fresh problems, the solution of which, right or wrong, must be found quickly, and on its correctness the lives of his men and possibly of a whole army may depend. No method of teaching which Mr. Talbot had found makes more demand on a boy's power of drawing conclusions and acting on them than the practical work in the laboratories. For this reason science should be compulsory in the qualifying examination, though not in the competitive one as it at present stands. Certain things militate against the adoption by candidates of science—the want of laboratory accommodation, the fact that the alternative subject, Latin, can be taught to all the boys at once, and that there are two examinations. In larger schools Mr. Talbot fancied that science is doing well in the struggle for existence. In conclusion, science masters were told that they could no longer grumble at a reactionary War Office; they must see to it that it is not able to talk of antiquated teachers. It would be a bad thing for the schools if there ever arose a military Osborne to supersede the science masters.

Sir Michael Foster bore out what Mr. Talbot had to say about the two halves of the examination. The committee on military education had had to face the fact that many an officer could not spell, and had no knowledge of accounts. The qualifying examination was to ensure that the candidate should at least be able to write a letter, and the competitive to prove that he had brains, and, being able to use them in some directions, might be likely to do the same in others. Subsequent speakers made it clear that many boys at the public schools took science in the qualifying examination if not in the other. The discussion turned afterwards on the difficulties of, and objections to, the practical examinations in science, especially when no examiner came to conduct them. As an alternative, it was suggested that the production of note-books kept in the laboratory to show that the candidate had been through a proper course of training should be accepted in lieu of practical tests, and should determine whether the owner should be allowed to sit at the theoretical examination.

An exhibition of scientific apparatus by various makers and members of the association was arranged in the laboratories of Westminster School in connection with the meeting. Two novelties were shown by Messrs. Brown and Son; the first was a combination of the conical condenser from their "Desideratum" still with a hot water oven, the hot water from the top of the condenser being used to feed the jacket of the oven. The other was a new suction and blast apparatus dependent upon water pressure, which worked almost instantaneously. Among the exhibits of the science masters themselves was a very neat method of rocking a flask or other vessel by placing under one edge of the circular base of the stand supporting it an india-rubber tube through which a current of water is passed. The Rev. E. C. Sherwood exhibited this, and also some exceedingly useful clamps designed by Mr. Barnes. Though adapted for almost any work, those shown were used by Mr. Sherwood on retort stands, and are wonderfully ingenious and effective. A spring prevents the clamp from sliding rapidly down the rod when the screw is released; the tightening of the latter not only fixes it on the

rod, but holds the arm perfectly immovable in any position, three contacts being made. The arm will support any weight that will not actually break it. On some clamps a micrometer screw allows the arm to be moved while supporting the full weight that it can carry. Those who have struggled with the old type of retort stand clamp which wobbles in all possible directions will welcome the new invention should it be put upon the market.

WILFRED MARK WEBB.

THE THIRD TANGANYIKA EXPEDITION.[1]

I LEFT London for Cape Town on March 24, 1904, proceeding thence to Chinde, and up the Zambesi and Shiré Rivers, to Blantyre and Zomba, in British Central Africa. In Zomba I reported myself to Sir Alfred Sharpe, and from him received much advice and assistance before leaving shortly for the Upper Shiré and Lake Nyasa. In the region of this lake I stayed, roughly, three weeks—one week on the gunboat anchored at the south end, one week ascending the lake, and a week in Karonga—before starting to cross the plateau to Tanganyika.

I collected, as far as possible in the short time, specimens to illustrate the flora of the lake—dried specimens, algæ scraped from rocks, &c., and tow-nettings containing diatoms and other of the more minute organisms. I made no systematic attempt to collect fish, but brought a few specimens, in addition to some leeches, crabs, a species of prawn (of interest as none had been hitherto recorded from the lake), and a sponge.

Karonga was left on July 5, and after an unavoidable delay on account of illness among my men, I arrived at Niamkolo, at the south end of Tanganyika, on July 27. I made this spot my headquarters for more than two months, though during the period I stayed a week at Kituta. I purchased at once a large dug-out canoe and hired a crew, so that I was able from the first to fish, dredge, and take tow-nettings. Meanwhile, I made arrangements with the owner of a large dau in Ujiji to hire his vessel, and this was dispatched to the south end of the lake to pick me up. I sailed on board the dau on September 23, and for the rest of my time on the lake cruised about, visiting as far as possible the most interesting and likely places on the lake shore. I camped on land whenever circumstances permitted, but my stays varied, according as I found much or little of value to me. Although I made some attempts, I found it almost impossible to dredge satisfactorily in deep water by means of the dau, so I was reduced to dredging from the canoe, in which case, of course, we had not sufficient power to dredge at any depth. On one occasion, by the kindness of the captain, I was permitted to make an attempt from the German gunboat, but unfortunately I lost the dredge and a large part of the rope, by the snapping of the rope under the strain.

I collected fish on every possible occasion, but though we tried various methods of catching them, the majority were obtained direct from the native fishermen. The largest fish I saw was a Siluroid (probably Clarias), 155 cm. in length, and weighing 30·6 kilograms. Tow-nettings were taken systematically at various times before and after dark, in various places and at various seasons. These consisted, as a rule, principally of phyto-plankton, but there were also prawns, copepods, ostracods, and insect larvæ taken in this fashion. The quantity of material obtained by tow-netting became markedly less during the rainy season. The larger representatives of the flora were also collected, but show, on the whole, little difference from the corresponding water-weeds of Nyasa. Scrapings from the rocks and submerged stems of plants produced various of the smaller algæ, while a few fungi were brought from the rotting wood of the canoe.

Five or six species of prawns were collected, in addition to those already known from the lake, some among the rocks at the water's edge, others by dredging in a few fathoms. Some two or three species of crabs were obtained, and at least two species of Argulus. These latter were perhaps most common from the mouth-cavity, gill-bars, and surface of the body of various large Siluroids, but they were also frequently present upon large specimens of Lates, and occasionally on other scaly fishes. Two forms of true parasitic copepods were found—one on the gills of a Siluroid, and the other attached at the junction of the pelvic fins of a Polypterus. Of worms, a few Oligochætes were collected and a considerable number of leeches.

In addition to these were some Turbellaria, and various endo-parasites—Cestoda, Trematoda, and Nematoda—principally from the gut of fishes. Among the Polyzoa is, at any rate, one form with horseshoe-shaped lophophore, which has not yet been described from Tanganyika. There is probably little of interest in the molluscs collected, as my work was confined to the comparatively shallow water. I was struck by the irregularity in the appearance of the Tanganyika medusa, or rather the uncertainty of finding it at any particular time or place. It is doubtless, like all such forms, driven to and fro by wind and currents, but it is curious that one may be a month or more on the lake without seeing a single specimen. I have brought back a few in formalin, for museum purposes, and others preserved with a view to the histology. Some quantity of sponge was collected, encrusting in every case submerged rocks or shells.

Apart from actual collecting, some observations of physical interest were made. Attempts were made, both on Nyasa and Tanganyika, to observe the seiche alterations in water-level, and at the south end of Tanganyika the actual level of the water was marked, with the view of affording some basis of comparison for the use of future investigators. A good many readings of the water temperature have been taken, which should prove interesting, as I believe nothing has ever been recorded from these lakes before. The temperature in general seems very high, the lowest obtained on the lake being only 73°·3, and the highest recorded 81°·0. At a depth of 76 fathoms (length of the sounding-line) the temperature appears fairly constant, for readings taken on various occasions, and at different spots, only vary between 74°·1 and 74°·8.

The total length of time spent on and around Tanganyika was about eight months. Dismissing the dau at Usumbura, at the north end of the lake, I began on March 18, 1905, the journey overland to the western shore of the Victoria Nyanza. This took rather longer than was expected, owing to the bad weather and the famine-stricken nature of the country, but Bukoba, a German station on Nyanza, was reached on April 16. During a stay of ten days waiting for the steamer, and during a short stay in Entebbe, the British capital, I was able to do some collecting in this lake also. As far as possible, representatives of the water flora were obtained, for the sake of comparison with the plants collected on Nyasa and Tanganyika. A few tow-nettings were taken, and, in addition to the smaller plants and animals thus obtained, there were also collected a few molluscs, some Argulus, and certain endo-parasites. More interesting was the finding of a species of prawn and a sponge, as no sponge had been recorded from the lake before.

[1] From a report by Mr. W. A. Cunnington, Christ's College, Cambridge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE council of King's College, London, has received a donation of 500*l.* from the Drapers' Company for the further equipment of the physics laboratory, especially for the promotion of research.

PROF. W. W. WATTS, F.R.S., assistant professor of geology and professor of geography at the Birmingham University, has been appointed professor of geology at the Royal College of Science, South Kensington, vacant by the retirement of Prof. J. W. Judd, C.B., F.R.S. In view of the changes in organisation that may be found desirable in the Royal College of Science and the Royal School of Mines after the consideration of the report of the departmental committee on the college, the appointment has been made a temporary one.

THE council of the Armstrong College of Durham University in Newcastle has resolved to found a chair of